Biomedische Technologie OW 2012

Faculty of Mechanical, Maritime and Materials Engineering
Delft University of Technology

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This report was finalized on 14 December 2012

Report on the master's programme Biomedical Engineering of Delft University of Technology

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point.

Administrative data regarding the programme

Master's programme Biomedical Engineering

Name of the programme:	Biomedical Engineering
CROHO number:	66226
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Medical Instruments and Medical Safety Biomechatronics Tissue Biomechanics and Implants Biomaterials Medical Imaging Medical Physics Biomedical Instrumentation
Location(s):	Delft
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2013

The visit of the assessment committee Biomedische Technologie OW 2012 to the Delft University of Technology took place on 23 and 24 October 2012.

Administrative data regarding the institution

Name of the institution:	Delft University of Technology
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

Quantitative data regarding the programme

The required quantitative data regarding the programme are included in Appendix 5.

Composition of the assessment committee

The committee that assessed the master's programme Biomedical Engineering consisted of:

- Prof. Dr. ir. J. Vander Sloten, professor in Engineering Sciences KU Leuven, Belgium;

- Dr. J. Struijk, associate professor Department of Health Science and Technology Aalborg University Denmark;
- Prof. Dr. Ir. J.A.E. Spaan, professor in Medical Physics, Academic Medical Center, University of Amsterdam;
- Prof. Dr. R. Reilly, professor in Neural Engineering Trinity College Dublin;
- J.Y. de Boer, bachelor student Biomedische Technologie Universiteit Twente.

The committee was supported by Drs. L. van der Grijspaarde, who acted as secretary.

Appendix 1 contains the curricula vitae of the members of the committee.

Working method of the assessment committee

Preparation

The assessment of the master's programme Biomedical Engineering of Delft University of Technology is part of a cluster assessment of seven Biomedical Engineering degree programmes offered by four universities. The entire cluster committee consists of six members. The kick off meeting for the cluster assessment was scheduled on 13 September 2012. During this meeting the committee members received an introduction into the assessment framework and evaluation procedures and the committee agreed upon its general working method. Furthermore the domain specific requirements and the most recent developments concerning the Biomedical Engineering domain were discussed. These domain specific requirements and the actual context form the starting point for the evaluation of the quality of the degree programmes.

In preparation of the assessment of the programme, a self-assessment report was prepared by the programme management. This report was sent to QANU and, after a check by the secretary of the committee to ensure that the information provided was complete, forwarded to the committee members. The committee prepared the site visit by studying the self-assessment report and a number of master theses. The secretary of the committee selected fifteen theses randomly and stratified out of a list of all graduates of the last two years. The following stratification is used: five theses with low grades (6-6.5), five theses with middle ranged grades (7-8) and five theses with high grades. QANU asked the programme to send the theses including the assessment by the supervisor and examiner and divided them among the committee members; each committee member therefore assessed three theses.

In the case that a thesis would have been assessed as questionable or unsatisfactory by a committee member, a reassessment was carried out by another committee member. In the case that more than 10% of the theses were assessed as questionable or unsatisfactory by two committee members the selection of theses for the programme would have been extended to 25 (which was not the case)

Site visit

The committee members formulated questions raised by studying the self-assessment report in advance. These questions were circulated in the committee.

The committee visited the programme on 23 and 24 October 2012**.** The programme of the site visit was developed by the committee's secretary in consultation with the programme

management and the chair of the committee. The committee interviewed, next to students, teachers and alumni, the programme management and representatives of the Faculty Board, the Examination Board and the student and teacher members of the Programme committee. An open office hour was scheduled and announced (but not used).

During the site visit the committee studied additional material made available by the programme management. Appendix 7 gives a complete overview of all documents available during the site visit. The last hours of the site visit were used by the committee to establish the assessments of the programme and to prepare the presentation of the findings of the committee to the representatives of the programme.

Report

The Secretary wrote a draft report based on the findings of the committee. The draft report has been amended and detailed by the committee members. After approval of the draft report by the committee it was sent to the programme for a check on facts. The comments by the programme were discussed in the committee, this discussion resulted in some changes in the report and subsequently the committee established the final report.

The assessment was performed according to the NVAO (Accreditation Organization of the Netherlands and Flanders) framework for limited programme assessment (as of 20 November 2011). In this framework a four-point scale is prescribed for both the general assessment and assessment of each of the three standards. The committee used the following definitions for the assessment of both the standards and the programme as a whole.

Decision rules

Generic quality
The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Unsatisfactory
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good
The programme systematically surpasses the current generic quality standards across its entire spectrum.

Excellent
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

General Assessment

When standard 1 or standard 3 is assessed as 'unsatisfactory', the general assessment of a programme is 'unsatisfactory'.

The general assessment of the programme can be good when at least two standards, including standard 3, are assessed as 'good',

The general assessment of the programme can be excellent when at least two standards, including standard 3, are assessed as 'excellent'.

Summary judgement

This report presents the findings and considerations of the committee that assessed the master's programme Biomedical Engineering of Delft University of Technology. The committee studied the information available and discussed the programmes with representatives of the institution and the programme during a site visit. The committee weighed their positive comments and the points for improvement found, and concluded that the programmes meet the current generic quality standards and shows an acceptable level across its entire spectrum. Therefore, the committee assesses the master's programme Biomedical Engineering as **satisfactory**.

The master's programme Biomedical Engineering (BME) is a joint programme of three faculties of Delft University of Technology, in collaboration with clinical partners at Leiden University Medical Centre, Erasmus Medical Centre Rotterdam, and Academic Medical Centre Amsterdam.

Standard 1: Intended learning outcomes
The committee assesses Standard 1 as **satisfactory**.

The goals of the programme are to educate academic engineers, who are technically high-skilled and have additional medical and biological knowledge. Graduates are capable to: 1) collaborate with clinicians, researchers and other healthcare professionals in order to identify, define and analyse biomedical problems, for the solution of which biomedical engineering principles and methods are important or essential; 2) develop and produce a sound solution to the problem; and 3) present these solutions effectively. The committee noticed that the programme has a strong focus on engineering/technology aspects of biomedical engineering. The students are trained to become engineers, who know how to specifically collaborate with clinical professionals.

The programme formulated eight final qualifications which were benchmarked with the domain-specific requirements as described by the biomedical engineering programmes of the Eindhoven University of Technology, the University of Twente and the University of Groningen. The committee appreciates how this domain is translated into the qualifications. According to the committee, the position within the domain, with a strong focus on the engineering aspect of biomedical engineering, is reflected in the final qualifications. However, the committee regrets that the knowledge and understanding of concepts of physiology, (cell-) biology, anatomy, biochemistry, pharmacology and pathology as applicable in the field of Biomedical Engineering has not been translated into final qualifications.

Standard 2: Teaching-learning environment
The committee assesses Standard 2 as **satisfactory.**

The master's programme Biomedical Engineering is a two-year programme and is taught in English. Most students begin their studies in September, but the programme accommodates mid-year entry as well.

The programme offers seven specializations. These are divided among three orientations. Firstly, there are four specializations with a mechanical engineering orientation. Secondly, there are two specializations focusing on applied physics. The last specialization is based on electrical engineering. Students select their specialization at the beginning of the programme.

In the first year, students are expected to take biomedical courses and fundamental engineering courses. Both the biomedical and the fundamental engineering courses are divided between compulsory courses specific to each specialization and electives that are chosen in consultation with the professor responsible for the specialization. The second year involves a traineeship in a biomedical research group or company and a literature survey, followed by a master thesis project.

The committee studied the content of the curriculum and concludes that all relevant aspects are included. The courses comprise basic knowledge in all fields related to biomedical engineering: mathematics, the sciences of the non-living systems, and life sciences. Integration of the various disciplines (including life sciences) occurs whenever possible and appropriate. There is a nice mix of teaching forms. The combination of course based education, assignments and laboratory work provides students with the opportunity to learn in a variation of environments. Within the programme, several essential skills are trained. The programme intents to deliver good researchers and engineers. According to the committee the didactic concept is in line with the aims of the programme; the students are enabled to achieve the intended learning outcomes.

The programme is composed as a joint programme with a contribution of three different faculties and three clinical partners outside the Delft University of Technology. The committee feels that this way of organisation is partly responsible for the fact that the programme does not have sufficient unity and may isolate students within their specialisation. The committee believes there is a need for expansion of the community and integrative aspects of the education. Alumni can be asked to help students with job opportunities, by teaching motivational lectures, and by helping students to select themes. The use of the Introduction week was recognised as of great opportunity to counter this risk and to promote all specialisations.

Standard 3: Assessment and achieved learning outcomes
The committee assesses Standard 3 as **satisfactory.**
For the assessment of this standard the committee studied the test policy and test regulations used in the programme and had a discussion with the Board of Examiners. To assess whether the students achieved the intended learning outcomes the committee studied test material and assessed a selection of fifteen theses.

The assessments used are adequately related to the programme. There is a variety of assessment forms. However, there is no system in place for assessing the traineeships. The committee strongly recommends to develop an assessment system for the traineeship to be commonly used, with a formal sheet including clear learning objectives, linked to the final qualifications.

The committee observes that there is one Board of Examiners for the Faculty of Mechanical, Maritime and Materials Engineering. The tasks and responsibilities for the Board of Examiners are increasing; the Board is already playing a pro-active role. The committee recommends that a subcommittee for BME should be considered in view of efficiency and to make this subcommittee more knowledgeable on BME.

The committee established that all selected theses met the requirements for graduation. On average the theses are of sufficient quality. The committee has not seen theses that were on the whole unsatisfactory. The theses illustrate that the students have achieved the intended learning outcomes as formulated by the programme.

Concluding statement
The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Standard 1: Intended learning outcomes	**satisfactory**
Standard 2: Teaching-learning environment	**satisfactory**
Standard 3: Assessment and achieved learning outcomes	**satisfactory**
General conclusion	**satisfactory**

The chair and the secretary of the committee hereby declare that all members of the committee have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 14 December 2012

Prof. dr. ir. J. Vander Sloten

drs. L. van der Grijspaarde

Description of the standards from the Assessment framework for limited programme assessments

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

Findings

For this standard, a short introduction to the programme is given (1.1). After that, the domain specific requirements are described (1.2). In addition, the goal and intended learning outcomes of the programme are described and discussed (1.3).

1.1 Introduction to the programme

The master's programme Biomedical Engineering is a joint programme of the Faculty of Applied Sciences, the Faculty of Electrical Engineering, Mathematics and Computer Science and the Faculty of Mechanical, Maritime and Materials Engineering of Delft University of Technology, in collaboration with clinical partners at Leiden University Medical Centre, Erasmus Medical Centre Rotterdam, and Academic Medical Centre Amsterdam. The administrative responsibility lies with the Faculty of Mechanical, Maritime and Materials Engineering. The programme has started in September 2004.

According to the self-evaluation report, this joint programme combines the strengths of the collaborating faculties in Delft.

In short, the goals of the programme are to educate academic engineers, who are technically high-skilled and have additional medical and biological knowledge. Graduates are capable to: collaborate with clinicians, researchers and other healthcare professionals in order to identify, define and analyse biomedical problems, for the solution of which biomedical engineering principles and techniques are important or essential; develop and produce a sound solution to the problem; and present these solutions effectively.

The committee noticed that the programme has a strong focus on engineering/technology. The students are trained to become engineers, who know how to collaborate with clinical professionals and generate sophisticated solutions. The committee discussed the different possible focuses with the programme management, wondering if it would not be easier to justify a more prominent medical flavour. The programme management made clear that they want the programme to have a close link with the biomedical engineering activities of the collaborating engineering faculties. Therefore, while the engineering aspects will always remain very important, it will be implemented in combination with the medical/clinical inputs of Rotterdam, Leiden and Amsterdam. The committee appreciates that the programme takes a clear position within the domain, especially when considering the pure engineering Bachelor's programme of Delft University of Technology.

1.2 Domain specific requirements

The objective of the master's programme Biomedical Engineering of Delft University in Technology is described in the domain statement. According to this domain statement, biomedical engineering is an interdisciplinary field, combining engineering disciplines and natural and life sciences. Integrating scientific and engineering concepts and methodology, the Biomedical Engineer works to increase scientific knowledge and solve health care problems, by:

1. acquiring new knowledge of living systems through continuous innovation and substantive application of experimental, analytical, and design techniques,
2. designing and developing new devices, algorithms, processes and systems to advance medical technology in health care,
3. solving health care problems through purposeful context-driven problem solving;
4. implementing solutions using cross-disciplinary communication and cooperation skills.

In 2005, domain-specific requirements for biomedical engineering in the Netherlands were developed by the biomedical engineering programmes of the Eindhoven University of Technology, the University of Twente and the University of Groningen. Recently, the three original partners and the Technical University Delft confirmed these domain-specific requirements. The domain-specific requirements are presented in appendix 2. According to the committee, the domain-specific requirements are well described in terms of orientation. They differentiate sufficiently between the bachelor's and master's level.

1.3 Intended learning outcomes of the programme

The programme formulated eight final qualifications (intended learning outcomes). These final qualifications are listed in appendix 3.

To define the final qualifications, the programme made use of the domain-specific requirements as described above. The committee appreciates that the programme translated the domain into its own qualifications. According to the committee, the position within the domain, with a strong focus on the traditional engineering part, is reflected in the final qualifications. The committee believes the final qualifications are clearly specified. However, the committee noticed that the knowledge and understanding of concepts of several disciplines (part b of the domain-specific requirements) is not translated in the final qualifications. The committee recommends to formulate learning outcomes in line with the content of the programme.

Considerations

The committee established that the master's programme offers the students the possibility to obtain thorough knowledge, insight and skills in Biomedical Engineering. The programme has a clear mission and clear goals. Within the domain, the programme takes a clear position with a strong focus on engineering knowledge and skills.

The programme makes use of the domain specific requirements of biomedical engineering. The committee is of the opinion that these domain specific requirements are well described in terms of orientation and that they show the academic level required for Master's programmes and in the 3 TU Criteria for Academic Master's Programmes.

The domain specific requirements are elaborated into eight specific final qualifications for the master's programme. According to the committee, these final qualifications are in general in line with the domain-specific requirements. The committee has some comments on the translation of some concepts into the final qualifications.

Conclusion

Master's programme Biomedical Engineering: the committee assesses Standard 1 as **satisfactory**.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings

The contents (2.1), the learning environment (2.2), the quantity and quality of the staff (2.3) and the facilities (2.4) of the programme are discussed below.

2.1 Contents of the programme

The content of the programme is described and discussed. In addition, the correspondence between the intended learning outcomes and the programme will be discussed.

2.1.1 Curriculum

The master's programme Biomedical Engineering is a two-year programme and is taught in English. Most students begin their studies in September, but the programme accommodates mid-year entry as well.

Specializations

The programme offers seven specializations. These are divided among three orientations. Firstly, there are four specializations with a mechanical engineering orientation:

- *Medical Instruments and Medical Safety* focuses on the development of instruments and methods for minimally invasive interventions, such as keyhole surgery, colonoscopy, and catheter interventions.
- *Biomechatronics* deals with the interdisciplinary study of biology, mechanics and electronics dealing with assistive and diagnostic devices for patients with movement disorders.
- *Tissue Biomechanics and Implants* focuses on artificial joints, bone, cartilage and tendons.
- *Biomaterials* integrates via an interdisciplinary approach the principles of materials science and engineering with those of chemistry, cell biology and physiology towards new functional biomaterials.

Secondly, there are two specializations focusing on applied physics:

- *Medical Imaging* addresses imaging technology and image analysis and interpretation for Computed Tomography, Magnetic Resonance Imaging, and diagnostic ultrasound.

- *Medical Physics* addresses the accuracy and safety of physical methods applied in hospitals for diagnosis and therapy, including radiotherapy, radiology, nuclear medicine and audiology.

The last specialization is based on electrical engineering:

- *Biomedical Instrumentation* focuses on smart sensor microsystems and low power electronics.

Students select their specialization at the beginning of the programme. Switching between specializations is possible in principle, but may require taking additional courses to facilitate the switch.

The committee believes that by distinguishing the seven specializations, the programme makes a clear choice and focuses on biomedical research and development within the fields of expertise of the department. The students reported to the committee that they are very positive about the number of specializations and the level of freedom to choose electives. According to the students, the flexibility of the programme serves students from all possible different backgrounds. The committee noticed that some of the specializations are very small, with three to five students in it. The committee discussed the consequences of the size of the specializations. It was explained to the committee that in general, courses are taken by at least fifteen students, because all courses can be chosen as an elective by other (biomedical) students.

As of there are seven different specializations, the committee examined whether students are sufficiently informed to be able to make a well-considered choice for a specialization and for electives. The committee feels that the information given at the start of the first year is quite adequate. During the first week, as part of the introduction, students get an overview of the specializations, of the courses and of the electives. In cooperation with the coordinator, the students choose their electives at the end of this first week. However, because of the importance of the subject, the committee recommends to monitor closely if students feel they were able to make well-considered choices, for example by evaluating the students immediately after their graduation.

Structure of the programme

The general structure of the programme is as follows:

Year 1	Biomedical course modules	30 EC
	Engineering course modules	30 EC
Year 2	Traineeship	15 EC
	Literature Study	10 EC
	Master Thesis Project	35 EC
Total		**120 EC**

Among the course modules, some are elective and others are compulsory. This depends on the specialization chosen. Approximately 50% of the courses (biomedical and engineering) are compulsory within a specialization.

First year

In the first year, students are expected to take at least 30 EC in biomedical courses and at least 30 EC in fundamental engineering courses. Both the biomedical and the fundamental engineering courses are divided between compulsory courses specific to each specialization

and electives that are determined in consultation with the professor responsible for the specialization.

Biomedical courses are predominantly taught by engineers with input from clinicians. Clinicians discuss clinical issues and explain their viewpoints, whilst also covering progress in clinically-related research. There are several medical courses that can be taken within the educational programmes of two of the clinical partner universities, Leiden University Medical Centre and Erasmus Medical Centre Rotterdam, such as Introduction to the Neurosciences, Echography and Surgery for Engineers. Students may take up to a maximum of 10 EC of these courses at Leiden and/or Rotterdam. The remaining biomedical courses (at least 20 EC) should be selected from courses at Delft University of Technology, which stress the engineering perspective of biomedical aspects. These course modules include topics such as Medical Imaging, Biomaterials, Medical Instruments and Biomechatronics.

The emphasis from the engineering perspective is placed on technical and biophysical aspects, such as the latest advances in design, modelling and simulation. Example course modules include Acoustical Imaging, Sensors and Actuators, Pattern Recognition, Man-Machine Systems and Numerical Analysis.

Second year

The second year involves a traineeship in a biomedical research group or company and a literature survey (in any order), followed by a master thesis project. Students are strongly advised to select a literature survey, traineeship and master thesis project within the same topic of research in order to be able to attain an internationally recognized level. Students discuss and plan the traineeship, literature survey and master thesis project with the professor of their chosen specialization.

- Traineeship (15 EC)

The second year starts with a traineeship in a biomedical research group or biomedical company. Bachelors who have graduated from a university of applied sciences (HBO) are exempted from this traineeship. Over the course of their traineeship students undertake a project determined in consultation with the host institute. It is encouraged that students undertake their traineeship abroad, which about 80% of the students indeed do.

- Literature study (10 EC)

In the literature study students learn to critically review and coherently present information from scientific and other publications. The literature study is generally defined as a preparation for the master thesis project, both with respect to scientific content and because it is the first major report to be written by the students.

- Master thesis project (35 EC)

The master thesis project is the final part of the programme. Ideally, the project is undertaken in collaboration with a clinical partner.

The committee studied the content of the curriculum and concludes that all relevant aspects are included. The courses comprise basic knowledge in all fields related to biomedical engineering: mathematics, physics and engineering, and life sciences. Integration of the various disciplines (including life sciences) occurs whenever possible and appropriate. A choice has been made for a curriculum towards highly specialized students. The committee believes that the link between education and research is very strong. Students are confronted directly with clinical research issues. The committee is positive about the guest lectures from

clinicians. However, adjacent to these positive remarks, the committee has some comments on the curriculum of the programme. These are discussed below.

As mentioned before, courses are offered by different faculties. Students reported to the committee that as a result, there is sometimes overlap between elective courses. Obligatory courses have a logical structure, according to the students. The committee recommends to monitor closely if students are able to construct coherent programmes containing courses with compatible course schedules. Students should be encouraged to select only courses with compatible course schedules.

In general, students are satisfied with the quality of the courses. However, the course 'Physiological Systems' seems to be insufficient for some students. For students who did have biology, it is an easy course. For others, the workload is too high. The teaching staff is aware of the problems and is already looking for improvements, for example by introducing a new textbook. In addition, the committee recommends to start differentiating between students with different backgrounds, maybe by changing the course partly into a self-study programme.

In general, the committee has some concerns about the amount of anatomy and physiology in the programme. The committee encourages the programme to emphasize more how the knowledge of concepts of anatomy and physiology that is acquired by the students is translated into the final qualifications.

The committee discussed the attention that is given to 'regulatory affairs' in the programme such as CE requirements and EU directives concerning medical devices. The committee believes that students need to be made more aware of regulations related to development and application of medical devices at the National and European level as well as those outlined by the FDA. According to the committee there is no need for exhaustive teaching on the topic, but it needs to be addressed at a sufficient level. A possibility is to link this topic closely to the traineeship, according to the committee.

The committee wondered if students who did not learn about a design methodology in their bachelor's (students from abroad for instance), are being brought to the intended level of achievement in design as formulated in the intended learning outcomes. There are several elective courses tailored to design. In addition, this topic is taught in some of the obligatory courses. Given the great experience in developing design skills in Delft University of Technology, providing students with information on how they can follow these courses as electives may compensate for those students who have not had exposure to design as part of their undergraduate programs.

The TU Delft offers the obligatory course Physiology. Furthermore the medical context is part of the obligatory course Medical Technology I and in a variety of other courses several aspects of medicine and its context are discussed as well. However the committee noticed that students can mainly extend their knowledge on biochemistry, physiology and medicine and a medical context by taking electives at the medical faculty in Leiden. Most of these courses are taught in Dutch, so foreign students are not able to choose for these electives. In addition, the committee recommends the programme to explore how elective courses (at other locations) can be brought more in line with the time schedule at Delft University of Technology.

2.1.2 Correspondence between intended learning outcomes and the curricula
Because the obligatory and elective parts consist of courses that serve as a preparation for the second-year projects, the Examining Committee[1] and the graduation supervisor or the programme coordinator must approve the chosen courses, in order to ensure a well-balanced and well-considered programme that covers the final qualifications.

According to the self-evaluation report, given the diversity of electives, it is not possible to draw meaningful conclusions regarding the relationship between these parts of the programme and the final qualifications (intended learning outcomes). For this reason, only the courses of the core programme can be related. According to the self-evaluation report, the core programme alone already covers seven of the eight final qualifications. The seventh qualification ('capability to evaluate and assess the technological, ethical and societal impact of one's work and to take responsibility with regard to sustainability, economy and social welfare') is covered in more detail during the traineeship and final graduation project. The eighth qualification ('attitude to maintain professional competence independently through life-long learning") is addressed minimally by the core course programme. It is covered primarily in the literature study, the traineeship and the graduation project.

The final qualifications of the programme are translated per course into specific learning objectives. As a result of the fact that courses are taught by different faculties, the learning objectives are diverse and not easy to link with the final qualifications. The committee studied the master's programme and concludes that in general, the programme offers students the possibilities to achieve the necessary knowledge and skills. However, for some final qualifications it is not easy to find the translation into the programme. The committee feels especially related to the eighth qualification that there is a need for a more clear translation in the criteria on the traineeship; the medical, clinical, societal and ethical aspects should be made more explicit for instance in the traineeship and the graduation project.

2.2 Learning environment
For the learning environment, the didactic concept, the student intake, the study load, study duration, and the dropouts are discussed. In addition, the tutoring, study advice and the quality assurance are discussed.

Didactic concept
According to the self-evaluation report, incoming students can be characterised as 'non-specialised researchers needing supervision'. The first year requires the embedding of new students from various backgrounds. The necessary embedding is accomplished through introductory activities, and the entire core programme. The focus is on the specialization of knowledge and skills within the domain of biomedical engineering. The second year focuses on developing students into independent specialised researchers.

The programme utilizes three educational formats: 1) the transfer of knowledge to students occurs through lectures, 2) imparting skills and attitude through assignments and 3) laboratory courses and projects which are closely connected to the lectures.

The first educational format, course-based education, consists of lectures and workshops with an examination for each course. This form is used for the engineering sciences, for domain-specific knowledge, as well as for elective courses. It may include exercises and project work designed to train students in practical application. In addition, a series of colloquia is part of

[1] The Board of Examiners appoints a Master's examining committee of at least three members to assess each Master's thesis. This committee is chaired by the graduation professor (see standard 3).

this educational form and is well implemented and forms a strong point in integrating the several streams within the program. Depending on the variant of a student's individual study programme, course based education involves 50% of the study load of the curriculum. The number of lecture and workshop hours is limited to approximately one third of the study load.

The second educational format consists of assignments. This form is used for the graduation project, the traineeship in industry or at a research institute and other assignments (e.g. literature survey). The assignments involve the entire second year of the programme, thus comprising 50% of the study programme.

The number of contact hours with supervisors during the assignments is limited to approximately 5% of the study load. The traineeship is intended to give students first-hand experience with and confront them with the level of work that will be expected of them after graduation. The graduation project is the final part of the study programme. It is intended to act as proof that students are able to conduct academic research independently and that they have obtained all final qualifications. The project also teaches students about the drawbacks and pitfalls of exploring unknown territories, and it helps them to understand that abstraction and simplification are their primary tools for success. As a rule this project will be executed in one of the research groups at the university under direct supervision of one of the scientists. The committee encourages the plans of the programme to extend the number of graduation projects executed within industry.

The third educational format consists of laboratory work. The purpose of this format is to apply knowledge of theory to laboratory settings, in which students gain hands-on experience with the application of theory.

The committee concludes that there is a nice mix of teaching forms available. The combination of course based education, assignments and laboratory work provides students the opportunity to learn in a varying environment. Within the programme, several essential skills are trained. The programme intents to deliver good researches and engineers and the didactic concept is, according to the committee, designed to do that.

As discussed before, the programme is composed as a joint programme with a contribution of three different faculties and three clinical partners. The committee feels that this way of organizing holds the risk that the programme does not form a strong unity and level of integration. This concern of the committee was confirmed by students and alumni. They reported to the committee that they miss a community sense under the students of the master's programme Biomedical Engineering. Last year, a first week introduction is implemented, and a study trip was organised for the first time in the summer. The committee feels that these initiatives are a good basis for creating a community. The committee suggests to develop this further, for example by introducing an electronic newsletter in which all research activities etcetera are linked, a common room for students and organising a network of alumni. The role of the student association might be reinforced. Alumni can be asked to help students with job opportunities, with teaching motivational lectures, and with helping students select themes.

Students reported to the committee that during their studies they acquire none or not enough knowledge of job opportunities or of existing large industrial/academic collaborations. The committee recommends to enlarge the attention for these collaborations throughout the programme.

Student intake
The programme accepts students from three categories:

1. Graduates holding an academic Bachelor's degree with relevant regular background, from a Dutch university. Given the interdisciplinary and interfaculty nature of the programme, admission is unrestricted to students who have obtained a specific BSc degree from a Dutch university. Relevant Bachelor's degree programmes include Applied Physics, Aerospace Engineering, Chemical Engineering, Electrical Engineering, Mechanical Engineering, Molecular Science and Technology, and Technical Mathematics. For students holding other academic BSc degrees from universities of applied sciences, the content of the BSc degree and study results of each candidate are evaluated.
2. International academic Bachelor's degree graduates with relevant background.
3. Higher professional Bachelor's degree graduates with relevant background, mostly from the Netherlands, after completion of an appropriate pre-Master's programme.

For the first category of students, admission is unconditional. For the second category, the admission procedure includes assessing the relevance and level of the applicant's diploma, English language proficiency and marks obtained. Students in the third category enrol in their respective pre-Master's programmes based on pre-specified requirements.

The committee studied the admission requirements and believes they are clear for each group of enrolling students.

Study load, study duration and dropouts
The committee concluded from the meetings with students and alumni that the study load of the programme is appropriate. The study load is strongly dependent on the background of students. Students did not report differences in work load between specializations.

According to the self-evaluation report, the assessment of the performance of students in the programme in terms of pass rate and progress is elusive. The reasons include the following: in recent years, Dutch academic students had been allowed to start Master's programmes before having obtained their BSc degree. The lack of a well-defined starting point made it impossible to calculate the actual time it took students to complete the programme. This issue does not apply to several specific groups, such as international students, who enter the programme after finalizing a BSc programme in their home country and a considerable portion of whom must complete their studies at a high pace due to visa requirements. The international students complete the programme within a period ranging from 20 to 48 months. On average, they take two and a half years to complete the programme (30.8 months). The performance of students with Bachelor's degrees from Dutch universities of applied sciences is similar to that of international students. These numbers suggest that a significant fraction of the students take more than two years to complete the programme.

In order to increase pass rates, the Delft University of Technology has intensified the monitoring and guidance efforts with regard to the progress of the students in both the first and the second year.

The dropout rate appears to be quite low (an average of 11% for international students and 10% for the students holding national Bachelor's degrees). For students holding the Dutch BEng degrees (pre-Master's students), however, the dropout rate is higher (approximately 30%). The following measures aim to improve this situation:

- Stricter admission conditions, including the implementation of the 'harde knip' for students of universities of applied sciences and limitation of the maximal study period for the pre-Master's programme.
- A new arrangement of the pre-Master's, in line with the plans for new Bachelor's degree programmes at the institution.

About half of the dropouts holding Dutch Bachelor's degrees had switched to other Master's degree programmes. Most dropouts from Dutch universities of applied sciences discontinued their pursuit of an academic degree at the Delft University of Technology, whereas 25% of the dropouts among international students switched to another master within the university.

Tutoring and study advice
Two types of counselling are arranged by the institution.

a) Study counselling
The variety of courses from various specializations can make it difficult for students to compile their individual study programmes. The study advisor or programme coordinator can support students in making their choices. Study counsellors/advisors/coordinators assist students with planning their programme and to solve study-related problems. Students receive counselling in various stages of their studies.

b) Academic counselling
The primary objective of academic counselling is to advise and support students with respect to any difficulties that might occur during their studies that are not directly related to the study. In the case of problems not directly related to the programme, the university has student psychologists and student counselling services.

The expertise of the university's student counselling services complements that of the academic counsellors.

These students and academic services work together to provide appropriate guidance to students. Participation in academic counselling is voluntary on the part of the students.

In addition to the study counselling and academic counselling, information sessions are held for prospective bachelor graduates and transfer entrants before the start of the programme.

The committee studied the tutoring and study advice provided for, and concludes that the guidance is well-coordinated and helps students enter and progress through the programme. Students know where to go to with questions or with problems.

Quality assurance
The committee discussed the quality assurance and the role of the educational committee with the members of this committee. The committee notices that the committee has seven staff members on board (one for each specialization) and three student members. The committee would like to stress that this is not an allowed composition. The amount of staff and student members should be equal. The programme management explained that they did not manage to attract more students for the educational committee. They invited the student association to come up with names. Because the committee noticed that some students are not aware of the existence of this committee, the committee recommends to try to attract students for example also by presenting the committee in lectures and recruit over there. The committee needs to be more visible for all students.

2.3 Quality and quantity of staff

Teachers of the course modules and supervisors of the graduation projects contribute to the programme. In most cases the daily supervision of the graduation project is done by a PhD researcher from the various research groups contributing to the research and a staff member, as graduation projects are strongly embedded into on-going research.

Since Master students can select and follow courses from the curricula of other Master's programmes, it is difficult to determine exactly what programme each student taking part in a certain course module belongs to. Therefore it has been decided to restrict the calculation of the student-staff ratio to the total student population enrolled at the Faculty of Mechanical, Maritime and Materials Engineering and to the total number of staff appointed at this Faculty. According to the self-evaluation report, this is a reasonable approximation since the core elements of the programme are taught by staff members of the faculty. On the one hand, non-biomedical engineering students take part in course modules, on the other hand teachers of other faculties teach classes in which students participate. In 2011, the student-staff ratio was 20.7.

For teaching staff, efforts are made to maintain and improve specific teaching abilities. A 3TU project group was established in 2009 in order to harmonise efforts with regard to the basic teaching qualification (in Dutch: Basiskwalificatie Onderwijs or BKO). During the tenure track, newly recruited academic staff members are required to take the BKO examination. For more senior academic staff members, the BKO qualification is required for promotion to the associate professor level.

According to the self-evaluation report, the efforts of the university to achieve excellent teaching qualities have contributed to student satisfaction with the programme. In general, the quality of the teaching staff is perceived as high by the committee.

The committee studied the information provided on the teaching staff and discussed the quality and quantity of staff in the meetings. Students report that the teaching in the programme is sufficient. All the lectures are good; staff members use their own research as a source for lectures and discuss their own research. However, the visibility of research could be improved, to allow students to make a choice on choosing their master theses project. Staff members either hold their BKO or are establishing a portfolio. A number of staff members have worked in industry and/or at a research institute. Some of them combine their job in industry with their function at the university. This ensures a thorough link with industrial practices, according to the committee.

The committee noticed that the teaching staff is under pressure, with respect to research, teaching and administration duties. This observation is supported by the Opinion Teaching Staff on Curriculum and Curriculum Organization, a document provided to the committee. In the future this pressure may increase. The work load balance therefore needs constant attention. The committee recommends to monitor this situation closely and readjust demands accordingly.

2.4 Facilities

According to the self-evaluation report, the different specializations each have well-equipped laboratories and technical support staff. Most experimental arrangements in the laboratory are available for both education (e.g. for master thesis projects) and research. Part of the

laboratory infrastructure is shared with the departments of Delft Centre for Systems and Control and Precision & Microsystems Engineering.

The committee thinks the facilities are adequate for realising the programme. The committee was led around the laboratories and was impressed by the diversity, quality and flexibility of the experimental research oriented setups with which master students can have excellent hands-on experience. The buildings are well equipped with state of the art facilities. Students from abroad do receive the necessary extra support.

Considerations

The committee studied the curriculum of the programme and concludes that the programme offers students sufficient depth in the engineering field, with links to the clinical practice. The programme enables the students to develop their competences in medical engineering on an advanced level and prepares the students for continuing their studies in a PhD programme or to fulfil a position in the labour market for which an advanced scientific education in (bio)medical engineering is required. According to the committee the master's programme is interesting and challenging.

The quality of the staff and of the programme-specific services and facilities enable the students admitted to achieve the intended learning outcomes.

Students have the possibility to shape their master's programme according to their own individual wishes and interests. They select elective courses that suit their field of specialization. To ensure a well-balanced programme with sufficient depth and diversity, the complete set has to be approved by the Examining Committee and the graduation supervisor.

Students participate in research departments and are involved in innovative high level research projects. The committee is convinced that the students receive sufficient guidance and supervision during their traineeship and graduation project.

The programme is composed as a joint programme with a contribution of three different faculties and three clinical partners. The committee feels that this way of organizing holds the risk that the programme does not form a strong unity. The committee believes that community building needs more attention e.g. by involvement of alumni in helping students with job opportunities, teaching motivational lectures, and helping students select themes.

Conclusion

Master's programme Biomedical Engineering: the committee assesses Standard 2 as **satisfactory**.

Standard 3: Assessment and achieved learning outcomes

The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

Findings

For this standard, the assessment methods (3.1) and the achieved learning outcomes (3.2) are discussed.

3.1 Assessment methods

The committee examined the learning assessment procedure and looked into a selection of assessments. The committee concludes that assessments are adequately related to the programme. There is a variety of assessment forms.

The committee studied the assessment criteria and the guidelines for traineeships. Students reported that they do not know in advance exactly how they will be assessed for their traineeship. The students' understanding of the guidelines for traineeships differs between specializations. Students are not assessed with the use of an assessment form at the end of the traineeship. There is an assessment form available, but this form is not known and used by the staff. The committee strongly recommends to develop a new assessment system for the traineeship to be commonly used, with a formal assessment sheet containing clear learning objectives, linked to the final qualifications.

The committee met with the Board of Examiners during the site visit and discussed the activities the Board carries out, in regard to the quality assurance of the exams. The Faculty of Mechanical, Maritime and Materials Engineering has one Board of Examiners for all its bachelor's and master's programmes, including the master's programme Biomedical Engineering. The Board of Examiners consists of at least six members. They are selected in such a manner that all the departments and all the educational programmes at the Faculty are represented. The Board is responsible for the rules and regulations of the examinations and the assessment of the examination results. The Board appoints a Master's examining committee of at least three members to assess each Master's thesis. This committee is chaired by the graduation professor.

The committee concludes that the Board of Examiners performs most of its legal tasks, but does not yet pro-actively monitors the quality of the exams, the assessment procedures and graduation theses. The committee believes that the current Board of Examiners has too many programmes to control and too little time to perform all of their tasks. The committee strongly recommends the Board to develop and implement in short time a quality assurance plan for assessments of every specific programme. Because of the busy agenda of the Board of Examiners, it might be useful to establish new committees for carrying out the assurance of assessment, for instance assessment committees ('toetscommissie') per programme. This would allow the faculty Board of Examiners to be more efficient and focused on overall quality assurance.

Staff members are invited one by one to develop assessment matrices ('toetsmatrijzen') and discuss these with the Board of Examiners. The committee is of the opinion that these assessment matrices make a contribution to valid assessments.

3.2 Achieved learning outcomes

The master thesis project is the final part of the programme. Ideally, the project is undertaken in collaboration with a clinical partner. Regardless of whether thesis work is carried out in Delft or at the premises of the clinical partner, most students will have a clinical tutor and a technical tutor. Roughly six weeks after the start of the master thesis project, students give an introductory presentation for a fellow student audience, in which the project goals, methodology and the research plan are presented. Students then prepare the thesis as a project report. Thesis work is evaluated by way of a public oral presentation (graduation seminar) by the candidate and an oral examination in a closed session with an examination committee composed of at least three scientific staff members, including the thesis supervisor and one staff member from outside the research group. In addition, the examination committee may also include external examiners from research institutes or from industrial partners.

The thesis is preferably composed of a report in journal paper format, accompanied by a number of appendices in which the work is explained in more detail. The journal paper format is a good exercise for the reporting skills of students, and if the research work is very good, it might be submitted for publication.

To assess whether the students achieved the intended learning outcomes the committee studied test material and assessed a selection of fifteen theses of the *master's programme Biomedical Engineering*. The committee established that all theses met the requirements for graduation. On average the theses are of sufficient quality. The committee has not seen theses that were on the whole unsatisfactory. The theses illustrate that the students have achieved the intended learning outcomes as formulated by the programme.

Two of the fifteen theses are graded considerably lower by the programme than by the committee. An assessment form was available for one of these theses. With this form, it became clear that the student did not work independently enough on his thesis project. For the other student, no record is available, so it is not able to determine why the difference in grading may exist. The committee strongly recommends to fill in assessment forms more consistently and store these, to be used for future reference.

Considerations

The committee has established that the master's programme has an adequate assessment system and assessment procedures. The assessment procedures are sufficiently implemented in the programme.

There is no uniformly used and clearly defined assessment system in place for assessing the traineeships. The committee strongly recommends to develop a new assessment system for the traineeship to be commonly used, with a formal assessment sheet with clear learning objectives, linked to the final qualifications.

The Board of Examiners performs most of its legal tasks, but does not yet pro-actively controls the quality of the exams, the assessment procedures and graduation theses. The

committee strongly recommends the Board to develop and implement a quality assurance for assessments.

The committee assessed fifteen master theses, and established that all theses met the requirements for graduation. On average the theses are of sufficient quality. The committee has not seen theses that were on the whole unsatisfactory. The theses illustrate that the students have achieved the intended learning outcomes as formulated by the programme.

Conclusion

Master's programme Biomedical Engineering: the committee assesses Standard 3 as **satisfactory**.

General conclusion

The committee concludes that master's programme Biomedical Engineering meets the requirements for accreditation. The intended learning outcomes are formulated in line with the Domain Specific Framework and the requirements for an academic master's programme. The curriculum enables the students to achieve the intended learning outcomes. The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Conclusion
The committee assesses the *master's programme Biomedical Engineering* as **satisfactory**.

Appendices

Appendix 1: Curricula Vitae of the members of the assessment committee

Prof. Dr. ir. J. (Jos) Vander Sloten obtained his PhD in Applied Sciences with Greatest Honours in 1990 at the KU Leuven. Since 1999 he is Full Professor at the Division of Biomechanics and Engineering Design of the KU Leuven. From 2006 until 2012 he was Programme director of the Master of Science programme in Biomedical Engineering at the same university. Since 2000, Professor Vander Sloten is chair of the CRITTO (Commissie Ruimtelijk Inzicht, Technisch Tekenen en Ontwerpen, Technologisch Instituut, Koninklijke Vlaamse Ingenieursvereniging). He is also a member of the Boards of Custom 8 N.V. (a KU Leuven spin-off company) and Materialise N.V., and is a member of various scientific advisory boards and editorial boards of scientific journals.

Dr. J. (Jan) Struijk obtained his PhD at the Biomedical Engineering Division of the University of Twente in 1992. His thesis was called *Immediate Effects of Spinal Cord Stimulation*. He was Visiting Professor in 1988, at Case Western Reserve University, Cleveland (USA). He was Associate Professor at the Department of Medical Informatics and Image Analysis at Aalborg University (Denmark). Subsequently, he was Director of Studies, Medicine and Technology, Head of Center for Sensory-Motor Interaction/Motor Control and Neurorehabilitation Technology, and since 2009 Associate Professor at the Medical Informatics Group, all of the Department of Health Science and Technology. He also was Chairman and member of several PhD evaluation committees.

Prof. Dr. ir. J.A.E. (Jos) Spaan is Emeritus Professor in Medical Physics at the Academic Medical Centre of the University of Amsterdam since February 2010. In 1970 he got a degree in Engineering, Physics at TU Eindhoven. In 1976 he obtained his PhD at the same university. His thesis was entitled *Oxygen transfer in layers of hemoglobin solutions*. He had appointments at various universities in the Netherlands: TU Delft, University of Leiden and University of Amsterdam. Professor Spaan also was Secretary General of the International Federation of BioMedical Engineering (1992-1998), Chairman of the Cardiovascular Research Institute Amsterdam (2003-2005) and the first elected president of the European Alliance of Medical and Biological Engineering and Sciences (2005).

Prof. dr. R. (Richard) Reilly got a degree in Biomedical Engineering (1989) and obtained his PhD in Biomedical Signal Processing (1992) at University College Dublin. He is and was researcher and biomedical engineer in various hospitals and institutes. He is currently Full Professor of Neural Engineering at the School of Medicine and School of Engineering of Trinity College Dublin and director of the Trinity Centre for Bioengineering. Professor Reilly also is President of the European Society of Engineering and Medicine (2011-2015).

J.Y. (Jan-Yme) de Boer is bachelor student Biomedical Engineering at the University of Twente. He is as board member of the Twente study association Paradoks and responsible for educational affairs. He is furthermore advisor to the Education Committee Biomedical Engineering at the University Twente and involved in the national meetings of Biomedical Study Associations.

Appendix 2: Domain-specific framework of reference

Mission statement Bachelor Biomedical Engineering

Biomedical Engineering is an interdisciplinary field, combining engineering disciplines and natural and life sciences. Integrating scientific and engineering concepts and methodology the Biomedical Engineer works to increase scientific knowledge and solve health care problems, by:

1) acquiring new knowledge of living systems through continuous innovation and substantive application of experimental, analytical, and design techniques.
2) design and development of new devices, algorithms, processes and systems to advance Medical Technology in health care.
3) solving health care problems through purposeful context-driven problem solving;
4) implementing solutions using excellent cross-disciplinary communication and cooperation.

Domain-specific reference framework and final qualifications

A. Domain specific requirements for level and orientation of graduates

Biomedical Engineering (biomedical engineering) is an engineering discipline focused at the interface of engineering and life sciences. biomedical engineering education should include basic general engineering requirements (as for example indicated by ABET) and a thorough understanding of life sciences. biomedical engineering programs must demonstrate that their students attain, according to the shared Dublin descriptors:

Knowledge and understanding:

a. Knowledge of the basic disciplines mathematics, sciences, and engineering (mechanical, electrical, and chemical engineering and applied physics) to be applied in the field of Biomedical Engineering in a broader sense; i.e. including directly adjacent fields.
b. Knowledge and understanding of concepts of physiology, (cell-) biology, anatomy, biochemistry, pharmacology and pathology as applicable in the field of Biomedical Engineering.

Applying knowledge and understanding:

c. The capability to apply and integrate advanced mathematics, sciences, and engineering to model and solve complex biomedical problems (see also d).

Making judgments:

d. An ability to conduct scientific research in areas of biomedical engineering and technology that are relevant to the advancement of knowledge and insight into fundamental and applied aspects of health and disease.
    - An ability to make measurements on and interpret data from living systems, addressing problems associated with the interaction between living and non-living materials and systems.
    - An ability to translate a clinical or health-relevant problem or question into an experiment, system, component, or process (design) to meet desired needs and, governed by scientific research or modelling, to advise in issues like clinical research in biomedical engineering, diagnosis and therapy.

Communication:

e. A capability to bridge the gap between fundamental and applied research in biomedical engineering and medical (life) sciences by:
   - Demonstrating an ability to communicate effectively in written and verbal form, and
   - Collaboration in a multidisciplinary setting, which may include clinicians, other healthcare workers and industrialists alike.

f. An awareness of potential societal and ethical implications of scientific research in Biomedical Engineering and, in this context, an ability to critically evaluate the effects of his research.

Learning skills:

g. An ability to develop new concepts within the field of biomedical engineering.
h. An ability to study international scientific research.
i. Recognition of the need for, and an ability to engage in life-long learning.

B. Domain specific requirements of the BSc (Cycle 1) and MSc (Cycle 2) programs

The Bachelor's program focuses on general knowledge, based on advanced textbooks and including some aspects informed by knowledge of the forefront of their biomedical engineering specialization, basic skills and solving recognizable problems.

The Master's program focuses on deepening theoretical knowledge in one or more specific parts of Biomedical Engineering and provides ample experience in setting up, executing and reporting research and design. It leads to an attitude of scientific involvement.

BSc students acquire knowledge and understanding in:

a. Basic beta disciplines: mathematics, sciences, and engineering (mechanical, electrical, and chemical engineering and applied physics) to be applied in the field of Biomedical Engineering in a broader sense; i.e. including directly adjacent fields.
b. Life sciences: physiology, (cell-) biology, anatomy, biochemistry, pharmacology and pathology as applicable in the field of Biomedical Engineering.

BSc students learn to apply knowledge and understanding:

a. Of mathematics, sciences and engineering to model and solve simple biomedical problems.

BSc students learn to make judgments:

b. Involving the making of measurements on and the interpretation of simple data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems at a basic level.
c. Involving the ability to translate simple clinical or health-relevant problems or questions into an experiment, system, component, or process to meet desired needs and, governed by scientific research or modelling, to advise in issues like clinical research in biomedical engineering, diagnosis and therapy.
d. By demonstrating an awareness of potential societal and ethical implications of scientific research in Biomedical Engineering and, in this context, an ability to critically evaluate the effects of his research.

BSc students learn to communicate:

e. By bridging the gap between fundamental and applied research in biomedical engineering and medical (life) sciences by:

- Demonstrating an ability to communicate effectively in Dutch in written and verbal form, and
- Collaboration in a multidisciplinary setting.

BSc students acquire learning skills:

f. As demonstrated in their recognition of the need for, and an ability to engage in lifelong learning at the BSc+ level with a high level of autonomy.

MSc students acquire knowledge and understanding:

a. Of in depth biomedical engineering, in a coherent set of specialties, that builds on the basic knowledge acquired in the Bachelor's phase, and that provides a basis or opportunity for originality in developing or applying ideas in this specialization.

MSc students learn to apply knowledge and understanding:

a. In order to apply and integrate advanced mathematics, sciences and engineering knowledge as well as specialized knowledge to model and solve complex biomedical problems in new and unfamiliar environments.

MSc students learn to make judgments:

b. In an ability to conduct scientific research in areas of biomedical engineering and technology that are relevant to the advancement of knowledge and insight into fundamental and applied aspects of health and disease.
- An ability to make measurements on and interpret complex data from living systems, addressing the complex problems associated with the interaction between living and non-living materials and systems, and the ability to successfully recognize and address new problems in this field.
- An ability to translate a complex, not well-defined, clinical or health-relevant problem or question into an experiment, system, component, or process to meet desired needs and, governed by scientific research or modelling, to advise in issues like clinical research in biomedical engineering, diagnosis and therapy.

MSc students learn to communicate:

c. With a capability to bridge the gap between complex fundamental and applied research in biomedical engineering and medical (life) sciences by
- Demonstrating the ability to communicate effectively in written and verbal form in Dutch and English, by underpinning knowledge and rationale (restricted scope) to specialist and non-specialist audiences alike, and
- Collaboration in a multidisciplinary setting, which may include clinicians, other healthcare workers and industrialists alike.

d. An awareness of potential societal and ethical implications of scientific research in Biomedical Engineering and, in this context, an ability to critically evaluate the effects of the research carried out under his responsibility.

BSc students acquire learning skills

e. An ability to study international scientific research.

f. Recognition of the need for, and an ability to engage in life-long learning at MSc+ level in a manner that may be largely self-directed or autonomous.

Appendix 3: Intended learning outcomes

Graduates of the *master's programme in Biomedical Engineering* are suitably qualified in the following areas:

1. Broad and profound knowledge of the engineering sciences (mathematics and applied physics) and the ability to apply this at an advanced level in one biomedical engineering specialization.
2. Broad and profound knowledge of science and technology and of the particular BME specialization and, moreover, the skills to use this knowledge effectively in biophysical modelling of human anatomy and physiology, data acquisition and processing as well as in the design of technical tools to analyse, monitor, assist and replace anatomical and physiological functions in a clinically effective, biocompatible, safe and cost-effective way. The discipline is mastered at different levels of abstraction, including a reflective understanding of its structure and relation to other fields, and reaching in part the forefront of scientific or industrial research and development. This knowledge forms the basis of innovative contributions to the discipline in the form of new designs or development of new knowledge.
3. Thorough knowledge of paradigms, methods and tools as well as the skills to actively apply this knowledge in analysis, modelling, simulating, designing and performing research with respect to innovative biomedical engineering, with an appreciation of different application areas.
4. The capacity to independently solve technological and biophysical problems in a systematic way through problem analysis, formulating sub-problems and providing innovative technical solutions, also in new and unfamiliar situations. This includes a professional attitude towards identifying and acquiring new areas of expertise, monitoring and critically evaluating existing knowledge, planning and executing research, adapting to changing circumstances, and integrating new knowledge with an appreciation of its ambiguity, incompleteness and limitations.
5. The capacity to work both in multidisciplinary teams and independently, interacting effectively with specialists, good communication skills and taking initiatives where necessary.
6. The capacity to effectively communicate (including presenting and reporting) details about one's work, such as solutions to problems, conclusions, knowledge and considerations, to both professionals and a non-specialist public, in the English language.
7. The capacity to evaluate and assess the technological, ethical and societal impact of one's work, and to take responsibility with regard to sustainability, economy and social welfare.
8. A commitment to independently maintaining one's professional competence through lifelong learning.

Appendix 4: Overview of the curriculum

Detailed programme per specialization

Per specialization, the main components and per component the study load, teaching method, and assessment method is indicated.

Specialization MIMS

Course Code	Course name	Study load (EC)	Teaching method	Assessment
BM1210	Medical instruments A: Clinical challenges and engineering solutions	3	lect	
BM1220	Medical instruments B: Quality assurance in design	2	lect	
ET4363	Medical Technology I (Diagnostic devices) & Health Care Systems	5	lect, pr	we-e
WB2308	Biomedical engineering design	4	lect, ex	r-p
WB2408	Physiological systems	3	lect	oe
WB2436-05	Bio-inspired design	3	lect	we
WB2301	System identification & parameter estimation	7	lect, ex	we-e
WBP202	Haptic system design	4	pr	r
BMA0115	Internship	15	pr	r
BMA0210	Literature survey	10	pr	r-p
BMA0335	Master thesis project	35	pr	r-p

Teaching Method:

lect	lectures
pr	project
ex	exercises

Assessment:

e	exercises
oe	oral examination
we	written examination
we-e	written examination and exercises
r	report
p	presentation
r-p	report and presentation

Specialization BM

Course Code	Course name	Study load (EC)	Teaching method	Assessment
BM1240	Musculoskeletal mechanics*	3	lect, ex	we-e
BM1250	Neuromuscular control	3	lect, ex	we-e
ET4363	Medical Technology I (Diagnostic devices) & Health Care Systems	5	lect, pr	we-e
WB2308	Biomedical engineering design	4	lect, ex	r-p
WB2408	Physiological systems	3	lect	oe
WB2432	Biomechatronics	4	lect, pr	we, r-p
WB2301	System identification & parameter estimation	7	lect, ex	we-e
WB1413-04	Multibody dynamics B	4	lect,ex	we
BMA0115	Internship	15	pr	r
BMA0210	Literature survey	10	pr	r-p
BMA0335	Master thesis project	35	pr	r-p

Teaching Method:

lect lectures
pr project
ex exercises

Assessment:

e exercises
oe oral examination
we written examination
we-e written examination and exercises
r report
p presentation
r-p report and presentation

Specialization TBI

Course Code	Course name	Study load (EC)	Teaching method	Assessment
BM1100	Orthopaedic implants and Technology	3	lect,ex	r
BM1200	Computational Mechanics of Tissues and Cells	6	lect,pr	we-r
BM1230	Selected Topics in Tissue Biomechanics and Implants	2	lect	r-p
BM1260	Tissue Engineering	3	lect, pr	we-r
ET4363	Medical Technology I (Diagnostic devices) & Health Care Systems	5	lect, pr	we-e
ME1610	Tissue Biomechanics of Bone, Cartilage and Tendon	3	lect	we
BM1101	Biomaterials	4	lect,ex	we
WB2408	Physiological systems	3	lect	oe
CT5123	Introduction to the Finite Element Method	4	lect	we-r
CT4353	Continuum Mechanics	6	lect,ex	we-r
BMA0115	Internship	15	pr	r
BMA0210	Literature survey	10	pr	r-p
BMA0335	Master thesis project	35	pr	r-p

Teaching Method:

lect lectures
pr project
ex exercises

Assessment:

e exercises
oe oral examination
we written examination
we-e written examination and exercises
r report
p presentation
r-p report and presentation

Specialization BMM

Course Code	Course name	Study load (EC)	Teaching method	Assessment
BM1101	Biomaterials	4	lect,ex	we
BM1102	Biomaterials mini-research projects	4	pr	r-p
ET4363	Medical Technology I (Diagnostic devices) & Health Care Systems	5	lect, pr	we-e
MS4240	Practical Course on the Characterization and Processing of Biomaterials	4	pr	r
WB2408	Physiological systems	3	lect	oe
LM3512TU	Systems biology	3	lect,ex	e
WB5414-08	Design of machines & mechanisms	4	lect,ex	we
BMA0115	Internship	15	pr	r
BMA0210	Literature survey	10	pr	r-p
BMA0335	Master thesis project	35	pr	r-p

Teaching Method:

lect lectures
pr project
ex exercises

Assessment:

e exercises
oe oral examination
we written examination
we-e written examination and exercises
r report
p presentation
r-p report and presentation

Specialization MI

Course Code	Course name	Study load (EC)	Teaching method	Assessment
AP3231TUD	Medical Imaging	6	lect, pr	we-r
ET4363	Medical Technology I (Diagnostic devices) & Health Care Systems	5	lect, pr	we-e
WB2408	Physiological systems	3	lect	oe
ET4283	Advanced Digital Image Processing	6	lect	we-r
IN4085	Pattern recognition	6	lect, ex	we-r
IN4086	Data visualization	6	lect, ex	we
BMA0115	Internship	15	pr	r
BMA0210	Literature survey	10	pr	r-p
BMA0335	Master thesis project	35	pr	r-p

Teaching Method:

lect lectures
pr project
ex exercises

Assessment:

e exercises
oe oral examination
we written examination
we-e written examination and exercises
r report
p presentation
r-p report and presentation

Specialization MP

Course Code	Course name	Study load (EC)	Teaching method	Assessment
AP3361TU	Medical physics and radiation technology Imaging	6	lect	we
AP3581TU	Medical physics and radiation technology Radiotherapy	6	lect	we
ET4363	Medical Technology I (Diagnostic devices) & Health Care Systems	5	lect, pr	we-e
WB2408	Physiological systems	3	lect	oe
AP3371TUD	Radiological health physics (+31 hours pract.)	6	lect, pr	we-e
AP3351TUD	Radiation detection and medical imaging	6	lect	we
BMA0115	Internship	15	pr	r
BMA0210	Literature survey	10	pr	r-p
BMA0335	Master thesis project	35	pr	r-p

Teaching Method:

lect lectures
pr project
ex exercises

Assessment:

e exercises
oe oral examination
we written examination
we-e written examination and exercises
r report
p presentation
r-p report and presentation

Specialization BI

Course Code	Course name	Study load (EC)	Teaching method	Assessment
ET4130	Bio-electricity	3	lect	we
ET4363	Medical Technology I (Diagnostic devices) & Health Care Systems	5	lect, pr	we-e
WB2408	Physiological systems	3	lect	oe
ET4248	Introduction to micro electronics	3	lect	r
ET4257	Sensors and Actuators	4	lect	we
ET4295	Introduction to Analog CMOS Design	4	lect	r
ET8017	Electronic instrumentation 1	5	lect	we
BMA0115	Internship	15	pr	r
BMA0210	Literature survey	10	pr	r-p
BMA0335	Master thesis project	35	pr	r-p

Teaching Method:

lect lectures
pr project
ex exercises

Assessment:

e exercises
oe oral examination
we written examination
we-e written examination and exercises
r report
p presentation
r-p report and presentation

Appendix 5: Quantitative data regarding the programme

Data on intake, transfers and graduates

Intake numbers 2004-2011

Cohort	Academic BSc	BEng	International	Total
2004-2005	11	11	6	28
2005-2006	10	2	6	18
2006-2007	18	10	3	31
2007-2008	17	4	9	30
2008-2009	21	6	8	35
2009-2010	28	4	8	40
2010-2011	25	4	13	42
2011-2012	26	3	21	50

Intake and graduation numbers per academic year

Year	Intake	Graduated
2004-2005*	28	2
2005-2006	18	1
2006-2007	31	5
2007-2008	30	16
2008-2009	35	20
2009-2010	40	24
2010-2011	42	27
2011-2012	50	18**

** First cohort of the BME programme*
*** Up to April 2012*

Teacher-student ratio achieved

Because of the high mobility of students among MSc programmes and mixed nature of classes (in which students of various MSc programmes participate), the programme can only approximate this ratio by calculating the staff-student ratio of the entire 3mE faculty. This ratio reached 1:20.7 in 2011.

Student-staff ratios for the Faculty of 3mE

Year	**Number of students 3mE** as per December 1st	**Total staff 3mE [FTE*]** as per December 31st	**Student/staff ratio**
2005	1,803	113.2	15.9
2006	1,914	126.2	15.2
2007	2,090	133.7	15.6
2008	2,308	133.3	17.3
2009	2,525	136.3	18.5
2010	2,633	137.8	19.1
2011	2,809	135.9	20.7

** All scientific staff members (full, associate, assistance and other lecturers) have been counted with respect to their total appointment within 3mE.*

Average amount of face-to-face instruction per stage of the study programme

Contact hours per phase of the programme

	Year 1:	***Year 2:***		
	Courses	**Traineeship**	**Literature**	**Master thesis**
Workload in hours (corresponding to ECTS)	1680	420	280	980
Contact hours per week	On average 10 hours/week	Ranging, dependent on local situation, from 1 to 5 hour/week	Approx. 1 hour/week	Approx. 1 hour/week (supervisor) plus 1 hour/week (daily mentor)
Contact hours per phase	420 (25%)	10-50 (2-12%)	7 (2.5%)	50 (5%)

Appendix 6: Programme of the site visit

Wednesday 24 October 2012

11.30-12.00 :	**Professional Field Experts** Dr.ir. J.S. (Jules) Scheltes, DEAM bv Dr.ir. J.E.N. (Joris) Jaspers, University Medical Centre Utrecht Dr.ir. W. (Wouter) Sjoerdsma, EMI – Erasmus Medical Centre Dr. F. (Frans) Steenbrink, Motek Medical bv Ir. F. (Frank) Nieuwenhuis, ForceLink bv Dr. C.G.M. (Carel) Meskers, Leiden University Medical Centre
12.00-13.00 :	**Management** Prof.dr. T.S. (Theun) Baller, Dean Faculty 3mE Prof.dr.ir. J. (Hans) Hellendoorn, 3mE Faculty Director of Education Prof.dr. F.C.T. (Frans) van der Helm, BME Programme Director, specialization Biomechatronics Prof.dr. J. (Jenny) Dankelman, specialization Medical Instruments and Medical Safety Dr. F.M. (Frans) Vos, specialization Medical Imaging Prof.dr. P.J. (Paddy) French, specialization Biomedical Instrumentation Dr.ir. D.H. (Dick) Plettenburg, BME Coordinator
13.00-13.45 :	**Lunch** **Consultation hour (not used)**
13.45-14.45 :	**Students** M. (Marije) Westra, student Medical Instruments and Medical Safety M.J.L. (Thijs) Perenboom, student Biomechatronics Y. (Yorick) Koumans, student Biomechatronics M.S. (Sophie) Borleffs, student Tissue Biomechanics and Implants M. (Martina) Cuschieri, student Biomaterials V. (Vasilis) Terzopoulos, student Medical Imaging A.L. (Astrid) Garretsen, student Medical Physics E.A.H. (Edgar) Roex, student Biomedical Instrumentation
14.45-15.45 :	**Staff** Dr. J. (Hans) Zoetelief, Applied Physics Dr.ir. W.A. (Wouter) Serdijn, Electrical Engineering Dr.ir. A. (André) Bossche, Electrical Engineering Dr.ir. P. (Paul) Breedveld, Mechanical Engineering Dr. J.J. (John) van den Dobbelsteen, Mechanical Engineering Dr. A.A. (Amir) Zadpoor, Mechanical Engineering
15.45-16.00 :	**Break**
16.00-16.30 :	**Programme Committee** Prof.dr. J. (Jenny) Dankelman, specialization Medical Instruments and Medical Safety Prof.dr. F.C.T. (Frans) van der Helm, BME Programme Director, specialization Biomechatronics Dr. A.A. (Amir) Zadpoor, specialization Tissue Biomechanics and Implants Dr.ir. I. (Iiulian) Apachitei, specialization Biomaterials Dr. F.M. (Frans) Vos, specialization Medical Imaging

Dr. J. (Hans) Zoetelief, specialization Medical Physics
Prof.dr. P.J. (Paddy) French, specialization Biomedical Instrumentation
Dr.ir. D.H. (Dick) Plettenburg, BME Coordinator
S.A. (Stephen) van 't Hof, chair student association Antonie van Leeuwenhoek

16.30-17.15 : **Examination Committee**
Examencommissie:
Dr.ir. C.A. (Carlos) Infante Ferreira, chair examination committee
Dr.ir S.A. (Sape) Miedema, examination committee
Dr.ir. P. (Paul) Breedveld, examination committee
Studieadviseur:
Drs. E. (Evert) Vixseboxse, academic counselor

17.15-17.30 : **Break**

17.30-18.00 : **Alumni**
Ir. M.H.T.M. (Marleen) Trommelen, alumna Medical Instruments and Medical Safety
Ir. M.P. (Martijn) Vlaar, alumnus Biomechatronics
Ir. W. (Willem) Nerkens, alumnus Tissue Biomechanics and Implants
Ir. N. (Nicole) de Groot, alumna Biomaterials
Ir. R.E. (Robiel) Naziroglu, alumnus Medical Imaging
Ir. P. (Pieter) Kruizinga, alumnus Medical Physics
Dr.ir. J.-W.H. (Jan-Wiebe) Korstanje, alumnus Biomedical Instrumentation

Thursday 25 October 2012

08.30-09.30 : **Guided Tour**
Three parallel tours: EWI, TNW en 3mE
Tour guides: TNW: Frans Vos en Hans Zoetelief
EWI: Paddy French
3mE: Frans van der Helm

09.30-10.30 : **Preparation final meeting Management**

10.30-11.15 : **Final conversation Management**
Prof.dr. T.S. (Theun) Baller, Dean Faculty 3mE
Prof.dr.ir. J. (Hans) Hellendoorn, Faculty Director of Education
Prof.dr. F.C.T. (Frans) van der Helm, BME Programme Director, specialization Biomechatronics
Prof.dr. J. (Jenny) Dankelman, specialization Medical Instruments and Medical Safety
Prof.dr. P.J. (Paddy) French, specialization Biomedical Instrumentation
Dr.ir. D.H. (Dick) Plettenburg, BME Coordinator

Appendix 7: Theses and documents studied by the committee

Prior to the site visit, the committee studied the theses of the students with the following student numbers:

1393618
121801
1151703
1233416
1266764
1333925
1391534
1382810
1290479
1542435
1262718
1228153
1194542
1066781
1386808

During the site visit, the committee studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

Information for Prospective BME-students

- Poster
- Flyer
- Doorstroommatrix
- Web-site: www.bme.msc.tudelft.nl
- BME Study Guide

Introduction Event for new MSc-students BME 2012-2013
Minutes BME Educational Board 2009 – present
Minutes Professional Review Committee 2009 – present
Obligatory Literature
Course Evaluations 2009 – present
Exam Examples

- WB2301
- BM1220
- WB2432

Regulations, Forms, Guidelines

- Teaching and Examination Regulations
- Rules and Guidelines for the Exams
- Rules and Guidelines for taking the MSc Examination
- Rules and Guidelines Honours Track Program Master
- Graduation Agreement
- Study Program in MSc Biomedical Engineering
- Form for Changes in MSc Programme
- Checklist Graduation Trajectory

- Global Timeline
- Internship Agreement
- Exam Application Form
- Form Examination Committee
- Evaluation Form for Literature Report
- Evaluation Form for Oral Presentations
- Evaluation Form for Graduation Thesis and Defense

Student Association Antonie van Leeuwenhoek

- Activity overview
- Studytrip 2012 – Programme
- Studytrip 2012 – Report

Basic Teaching Qualification: an example
Opinion Teaching Staff on Curriculum and Curriculum Organization

Appendix 8: Declarations of independence

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nederlands - vlaamse accreditatieorganisatie

DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: Jos Vander Sloten

HOME ADDRESS: Langestraat 69
3190 Boortmeerbeek
Belgium

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / SECRETARY:

BSc & MSc TU Twente

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

nvao
nederlands - vlaamse accreditatieorganisatie

HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: Boortmeerbeek DATE: 11/9/12

SIGNATURE:

2

Q3C9

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nederlands - vlaamse accreditatieorganisatie

DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: Johannes J. Struijk

HOME ADDRESS: Aalborgvej 11
9575 Terndrup
Denmark

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / SECRETARY:

Biomedical Technology B.Sc.
Biomedical Engineering M.Sc.

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

University of Twente

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

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nederlands - vlaamse accreditatieorganisatie

HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: Aalborg DATE: 10 sept. 2012

SIGNATURE:

2

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Jos A E Spaan

PRIVÉ ADRES:

C. Boyerstraat 10
1325 LH Almere

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Biomedical Engineering,

AANGEVRAAGD DOOR DE INSTELLING:

TUE

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

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VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Eindhoven DATUM: 6 juli 2012

HANDTEKENING:

2

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DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: Richard Reilly

~~HOME~~ Office ADDRESS: Trinity College Dublin, Dublin 2, Ireland

home address 10 Nutley Road
Ballsbridge
Dublin 4, Ireland

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / SECRETARY:

University of Twente BSc and MSc Biomedical Engineering

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

University of Twente

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

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nederlands - vlaamse accreditatieorganisatie

HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: University of Twente DATE: 13/7/2012

SIGNATURE:

2

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nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Jan-Jme de Boer

PRIVÉ ADRES: Witbreukseweg 377-010
7522-ZA
Enschede

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN D OPLEIDING:

Master Biomedical Engineering

AANGEVRAAGD DOOR DE INSTELLING:

T.U. Delft

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN ME BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEI VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAI DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEI BEÏNVLOEDEN;

1

nvao
nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Enschede

DATUM: 11 mei 2012

HANDTEKENING:

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nederlands - vlaamse accreditatieorganisatie

DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: Linda van der Grijspaarde

HOME ADDRESS:

Opwierderweg 150
Oppingedam

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS ~~AN EXPERT~~ / SECRETARY:

Biomedical Engineering

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

Universiteit Twente, TU Delft, TU/e

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

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HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: Oppingedam

DATE: 21 november 2012

SIGNATURE:

2